

REMARKS

Claims 45, 46, 50-52, 54, 56, 59, 60, 68-70, 73, 74 and 77 are pending in this application. Claim 55 has been canceled and its subject matter has been incorporated in amended independent claim 73. Claim 56 has been amended to correct claim dependency. No new matter has been introduced. Applicant acknowledges with appreciation the allowance of claims 45, 46, 50-52 and 68-70.

Claims 54, 56, 59, 60, 73 and 74 stand rejected under 35 U.S.C. § 112, first and second paragraph, on the basis that the term “a doping concentration of said first area” in claim 73 “appears wrong.” (Office Action at 2). Independent claim 73 has been amended to recite that “said increased doping concentration [is] higher than a doping concentration of said area of said substrate” correcting, therefore, any perceived indefiniteness. Applicant respectfully submits that all pending claims are now in full compliance with 35 U.S.C. § 112.

Claims 54, 56, 73, 74 and 77 stand rejected under 35 U.S.C. § 103 as being unpatentable over Schuegraf et al. (U.S. Patent No. 5,702,976) (“Schuegraf”) in view of Kooi et al. (U.S. Patent No. 3,755,001) (“Kooi”) and Joo et al. (U.S. Patent No. 5,841,163) (“Joo”). This rejection is respectfully traversed.

The claimed invention relates to isolation trenches formed of two dielectric materials. As such, amended independent claim 73 recites a memory device comprising *inter alia* “a field isolation region” separating a plurality of active regions and including “an isolation trench.” Amended independent claim 73 further recites that the isolation trench includes “a first area filled with a first dielectric material forming at least sidewalls of said isolation trench, and a second area filled with a second dielectric material situated within said sidewalls.” Amended independent claim 73 also recites “an ion implanted region provided below said second area having an increased doping concentration in an area of said substrate between said separated active regions, said increased doping concentration being higher than a doping concentration of said area.” Amended independent claim 73 further recites that “substantially all ions from said ion implanted region which increase said

doping concentration are displaced away from said active regions by a distance at least equal to a sidewall thickness of said first area filled with said first dielectric material, wherein the sidewall thickness of said first area is less than about forty percent the width of the isolation region.”

Schuegraf relates to “a trench isolation process which alleviates the problem of void formation during dielectric refill.” (Col. 2, lines 49-51). According to Schuegraf, “recesses (22) preferably having a trench profile” are formed by removing portions of a semiconductor substrate 10. (Col. 2, lines 60-61; Figure 3A). Schuegraf teaches that “[t]he trenches (22) are then refilled with a material (26) having a dielectric constant lower than the dielectric constant of silicon dioxide.” (Col. 2, lines 61-63; Figure 3D). To avoid contamination of substrate regions adjacent to trenches 22, Schuegraf further teaches that “it is preferable to form a barrier layer 24 over the trenches 22 prior to dielectric refill.” (Col. 5, lines 9-12; Figure 3B). In this manner, by “utilizing dielectric materials having a lower dielectric constant than used in the prior art,” the shallow trench isolation of Schuegraf “maintains effective device isolation.” (Col. 4, lines 37-40).

Kooi relates to a method of fabricating semiconductor devices having selective doping and selective oxidation. (Title; Col. 1, lines 4-11). As part of the fabrication of “a target plate (1) for converting electromagnetic radiation into electric signals,” Kooi teaches that grooves 4 formed into plate 1 of n-type silicon “are covered with a layer 5 of silicon oxide which at the bottom of the grooves adjoins a surface zone 6 of n-type silicon having higher doping than the region 1.” (Col. 6, lines 9-20; Figures 1-2).

Joo relates to integrated circuit structures having wide and narrow channel stop layers which are formed by employing a first and second field insulation layers coupled with a first and second channel stop impurity layers. (Col. 3, lines 38-47). For example, Joo discloses that impurity ions are implanted below the first field oxide layer and are diffused by a thermal process to form a second channel stop impurity layer. (Col. 6, lines 36-50; Figure 15).

The subject matter of claims 54, 56, 73, 74 and 77 would not have been obvious over Schuegraf in view of Kooi and Joo. Indeed, the Office Action fails to establish all elements of a *prima facie* case of obviousness. Specifically, the prior art references, whether considered alone or in combination, fail to teach or suggest all limitations of amended independent claim 73. None of Schuegraf, Kooi and Joo teaches or suggest trenches separating “a plurality of doped active regions” and having a first and a second areas filled with corresponding dielectric materials as well as “an ion implanted region . . . below said second area . . . *substantially all ions from said ion implanted region . . . displaced away from said active regions by a distance at least equal to a sidewall thickness of said first area filled with said first dielectric material, and wherein the sidewall thickness of said first area is less than about forty percent the width of the isolation region,*” as amended independent claim 73 recites (emphasis added).

Schuegraf discloses trenches which are “refilled with a dielectric material” with low dielectric constant and which may be lined with a barrier layer 24 prior to the dielectric refill. (Col. 3, lines 61-62). However, Schuegraf does not teach or suggest an ion implanted region directly below the second dielectric area, as in the claimed invention. Schuegraf is also silent about any ions from an ion implanted region “being displaced away from” the active regions, as independent claim 73 recites. In fact, Schuegraf does not even mention the existence of active regions in the “Detailed Description,” or illustrate any such active regions in the “Drawings.”

Kooi also does not disclose an isolation trench or “a first area filled with a first dielectric material forming at least sidewalls of said isolation trench, and a second area filled with a second dielectric material situated within said sidewalls,” as amended independent claim 73 recites. Further, Kooi does not disclose “an ion implanted region” located “below said second area,” as amended independent claims 73 recites. Kooi is also silent about the ion displacement limitations of claim 73. As shown in Figures 8 and 10 of Kooi, the ion implanted regions 6 and 28 are in contact with the dielectric materials 5 and 29, respectively, but these dielectric materials are simply not part of an isolation trench.

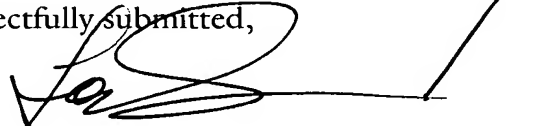
Joo also fails to disclose an isolation trench, much less first and second areas filled with first and second dielectric materials, or an ion implanted region below the second area, or that substantially all ions in the implanted region are displaced away from the separated active regions, as amended independent claim 73 recites. Joo teaches a “first channel stop impurity layer 67” formed beneath the second field oxide layer 66 and “a second channel stop impurity layer 68 beneath the first field oxide layer 65.” (Col. 6, lines 1-3; 35-37; Figure 15). In Joo, however, the first and second channel stop impurity layers and the first and second field oxide layers are not part of an isolation trench, much less of an isolation trench filled with first and second dielectric materials, as in the claimed invention.

A marked-up version of the changes made to the claims by the current amendment is attached. The attached page is captioned “Version with markings to show changes made.”

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,



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Version With Markings to Show Changes Made

73. (Three Times Amended) A memory device comprising:

a semiconductor substrate including a plurality of doped active regions;

a field isolation region separating at least two of said active regions, said field isolation region including an isolation trench, said isolation trench further including a first area filled with a first dielectric material forming at least sidewalls of said isolation trench, and a second area filled with a second dielectric material situated within said sidewalls, said first dielectric material being different than said second dielectric material; and

an ion implanted region provided below said second area having an increased doping concentration in an area of said substrate between said separated active regions, said increased doping concentration being higher than a doping concentration of said [first] area of said substrate, wherein substantially all ions from said ion implanted region which increase said doping concentration are displaced away from said active regions by a distance at least equal to a sidewall thickness of said first area filled with said first dielectric material, and wherein the sidewall thickness of said first area is less than about forty percent the width of the isolation region.

56. (Amended) The memory device of claim [55] 73, wherein the first dielectric material has a thickness of at least about one hundred angstroms.